WHAT IS CLAIMED:

1. A three-dimensional imaging system, comprising:

a three-dimensional display;

an image scanning device for capturing a three-dimensional image to be displayed on said three-dimensional display; and

three-dimensional calibration equipment for calibrating said image scanning device,

wherein both said three-dimensional display and said image scanning device employ optical pulses and non-linear optics to display and record, respectively, a three-dimensional image.

2. The three-dimensional imaging system of Claim 1, wherein said image scanning device is a three-dimensional imaging system.

3. The three-dimensional imaging system of Claim 1, wherein said image scanning device is a two-dimensional imaging system.

4. The three-dimensional imaging system of Claim 3, wherein said two-dimensional imaging system includes at least one two-dimensional camera.

5. A three-dimensional display, comprising:

at least three pulsed optical sources; and

an optical mixer movable in a display space,

wherein said at least three pulsed optical sources are spatially separated so as to permit pulses emanating therefrom to overlap in a voxel within said display space and intersecting said optical mixer at a selected position, whereby a first-order non-linear interaction of said pulses causes said optical mixer to produce at least one pre-determined wavelength of electromagnetic waves.

6. The three-dimensional display of Claim 5, wherein said optical mixer includes a plurality of non-linear mixing elements.

7. The three-dimensional display of Claim 5, wherein said pulses emanating from said at least three pulsed optical sources are ultra short optical pulses.

8. The three-dimensional display of Claim 5, wherein said ultra short optical pulses have a pulse width in the range of femtoseconds to nanoseconds.

9. The three-dimensional display of Claim 5, further comprising at least one optical filter adapted to permit the passage of said at least one pre-determined wavelength.

10. The three-dimensional display of Claim 6, wherein said at least three pulsed optical sources includes K pulsed optical sources, where K is greater than or equal to three.

11. The three-dimensional display of Claim 6, wherein said optical mixer recurrently sweeps through every voxel of a plurality of voxels in said display volume.

12. The three-dimensional display of Claim 11, wherein said optical mixer is planar in shape.

13. The three-dimensional display of Claim 11, wherein said optical mixer moves such that the normal to a centroid of said optical mixer maintains a constant direction.

14. The three-dimensional display of Claim 11, wherein said optical mixer rotates about an axis.

15. The three-dimensional display of Claim 11, further comprising display electronics.

16. The three-dimensional display of Claim 13, wherein said optical mixer is of a shape such that said optical mixer is capable of producing desired

wavelengths in each voxel of the display volume and a mapping of said shape is known to said display electronics.

17. The three-dimensional display of Claim 16, wherein said display electronics selects combinations of a subset of said K pulsed optical sources to produce desired wavelengths at desired voxels a nd stores alternative possible combinations of said K pulsed optical sources as lists of predetermined pulsed optical source combinations, and wherein said predetermined lists of alternative possible combinations of pulsed optical sources equalize the peak intensity of the desired wavelengths produced from said combinations of said subset of said K pulsed optical sources.

18. The three-dimensional display of Claim 6, wherein a subset of said K pulsed optical sources operate so as to excite said optical mixer in a plurality of voxels with a predetermined combination of optical frequencies so as to produce a plurality of desired wavelengths in a time interval that is much less than the repetition rate of movement of said optical mixer so that persistence of vision of the viewer makes the illumination of said voxels appear to be simultaneous.

19. The three-dimensional display of Claim 18, wherein different subsets of said K pulsed optical sources are chosen for different voxels and different positions of said optical mixer so as to maintain an approximately constant conversion efficiency.

20. The three-dimensional display of Claim 18, wherein each of said plurality of non-linear mixing elements has a cone of acceptance which is used to select the different subsets of said K pulsed optical sources for different voxels and different positions of said optical mixer.

21. The three-dimensional display of Claim 18, wherein said K pulsed optical sources operate so as to excite said optical mixer in said plurality of voxels to produce said desired wavelengths.

22. The three-dimensional display of Claim 18, wherein one of said K optical sources emits a gating pulse of a pre-selected intensity and pulse width so as to control the brightness of the light produced in said plurality of voxels.

23. The three-dimensional display of Claim 18, wherein at least one of said K pulsed optical sources emits pulses of longer duration than the pulses emitted by the remaining K-1 pulsed optical sources.

24. The three-dimensional display of Claim 5, wherein each of said at least three pulsed optical sources includes a wavelength generator and a lens for focusing a wavelength of light.

25. The three-dimensional display of Claim 24, wherein said wavelength generator is a point source of light and is located at the focal point of said lens.

26. The three-dimensional display of Claim 5, wherein each of said at least three pulsed optical sources includes a wavelength generator, an optical splitter for dividing an optical pulse emitted by said wavelength generator into at least three optical pulses, and a pulse controller for independently delaying and attenuating each of said at least three optical pulses.

27. The three-dimensional display of Claim 5, wherein said optical mixer moves periodically at a rate of repetition of at least twenty frames per second.

28. The three-dimensional display of Claim 6, wherein said plurality of non-linear mixing elements is composed from a non-linear optical material chosen from the group consisting of $LiNbO_3$, $LiIO_3$, KH_2PO_4, Tl_3AsSe_3 (TAS), Hg_2Cl_2, KH_2PO_4 (KDP), KD_2PO_4 (DKDP or D*KDP), $NH_4H_2PO_4$ (ADP), Hg_2Br_2 and $BaTiO_3$, quantum well structure semiconductors made of GaAs, etc.; organic single crystals made of 4-nitrobenzylidene-3-acetamino-4-methoxyaniline (MNBA), organic single crystals made of 2-methyl-4-nitroaniline (MNA); conjugated organic high molecular

compounds made of polydiacetylene, conjugated organic high molecular compounds made of polyarylene vinylene, semiconductor grain-dispersed glass comprising CdS dispersed in glass, and semiconductor grain-dispersed glass comprising CdSSe dispersed in glass.

29. The three-dimensional display of Claim 6, wherein each of said plurality of non-linear mixing elements further includes at least three sub-elements, each of which is made of a non-linear optical material that is optimized for a desired wavelength.

30. The three-dimensional display of Claim 29, wherein each of said sub-elements is optimized to produce a primary color chosen from the group consisting of red, blue, and green.

31. The three-dimensional display of Claim 30, wherein said sub-elements are arranged and spaced such that no two types of sub-elements optimized for the same desired wavelength are adjacent to one another.

32. The three-dimensional display of Claim 29, wherein each of said plurality of non-linear mixing elements further includes a non-linear mixing material.

33. The three-dimensional display of Claim 32, wherein each of said plurality of non-linear mixing elements further includes a lens for improving the cone of acceptance of said optical mixer sub-elements.

34. The three-dimensional display of Claim 33, wherein each of said plurality of non-linear mixing elements has a desired wavelength filter.

35. The three-dimensional display of Claim 33, wherein each said plurality of non-linear mixing elements has a diffuser for improving the viewing angle of said optical mixer.

36. The three-dimensional display of Claim 34, wherein said lens is hemispherical, said non-linear mixing material i s rectangular, and said wavelength filter is rectangular.

37. The three-dimensional display of Claim 34, wherein each of said plurality of non-linear mixing elements has an optical reflector positioned adjacent to said lens.

38. A three-dimensional image scanner for capturing a three-dimensional image of an object, comprising:

a first pulsed optical source for generating an illuminating optical pulse at an illumination wavelength, said first pulsed optical source directing said illuminating optical pulse toward the object;

a second pulsed optical source for generating a gating optical pulse at a gating wavelength;

an optical mixer positioned to receive light reflected from the object at a single wavelength in response to interaction of said illuminating optical pulse with the object, a portion of said illuminating optical pulse and a portion of said gating optical pulse spatially and temporally overlapping each other within the optical mixer, thereby producing a first optical pulse indicative of the shape of the object and a second optical pulse indicative of the color of the object; and

an optical recorder having a plurality of pixels responsive to output light emitted by said optical mixer, a first portion of said plurality of pixels having an associated filter which passes said first optical pulse and which blocks said second optical pulse, and a second portion of said plurality of pixels being unfiltered.

39. The three-dimensional image scanner of Claim 38, further comprising display electronics for controlling the relative timing of said first pulsed optical source and said second pulsed optical source.

40. The three-dimensional image scanner of Claim 38, wherein said filter is a coating on said first portion of said plurality of pixels.

41. The three-dimensional mage scanner of claim 38 wherein said optical mixer includes a plurality of non-linear mixing elements, each of which is

placed directly in front of a corresponding one of said plurality of pixels and said filter.

42. The three-dimensional image scanner of Claim 38, wherein said optical recorder has a planar shape.

43. The three-dimensional display of Claim 38, wherein pulses emanating from at least two of said at least three pulsed optical sources are ultra short optical pulses.

44. The three-dimensional display of Claim 38, wherein said ultra short optical pulses have a pulse width in the range of femtoseconds to nanoseconds.

45. The three-dimensional display of Claim 41, wherein each of said plurality of non-linear mixing elements is composed from a non-linear optical material chosen from the group consisting of $LiNbO_3$, $LiIO_3$, KH_2PO_4, Tl_3AsSe_3 (TAS), Hg_2Cl_2, KH_2PO_4 (KDP), KD_2PO_4 (DKDP or D*KDP), $NH_4H_2PO_4$ (ADP), Hg_2Br_2 and $BaTiO_3$, quantum well structure semiconductors made of GaAs, etc.; organic single crystals made of 4-nitrobenzylidene-3-acetamino-4-methoxyaniline (MNBA), organic single crystals made of 2-methyl-4-nitroaniline (MNA); conjugated organic high molecular compounds made of polydiacetylene, conjugated organic high molecular compounds made of polyarylene vinylene, semiconductor grain-dispersed glass comprising CdS dispersed in glass, and semiconductor grain-dispersed glass comprising CdSSe dispersed in glass.

46. A method for calibrating a three-dimensional imaging system having optical apparatus for capturing an optical image of a desired object from at least two positions, comprising the steps of:

projecting a virtual calibration pattern in the field of view of the optical apparatus;

choosing one position of the optical apparatus as a reference position;

assigning coordinates of a coordinate system relative to either the virtual calibration pattern or the reference position;

measuring the differences in the virtual calibration pattern from a second position of the optical apparatus;

calculating calibration corrections relative to the reference position based on the differences measured; and

adjusting the optical apparatus based on the calibration corrections.

47. The method of Claim 46 further including the step of assigning the coordinate system at the second position.

48. The method of Claim 47, wherein the optical apparatus includes a single optical recorder that moves between a reference and a displaced position.

49. The method of Claim 48, wherein said single optical recorder is a three-dimensional camera.

50. The method of Claim 48, wherein said single optical recorder is a two-dimensional camera.

51. The method of Claim 48, wherein said single optical recorder includes an electronic imaging detector comprising a pixel array and said step of assigning coordinates is either in parallel to the pixel array or normal to the pixel array.

52. The method of Claim 47, wherein the optical apparatus includes at least two optical recorders, one of which is located at a reference position and another of which is located at a displaced position.

53. The method of Claim 52, wherein said at least two optical recorders are three-dimensional cameras.

54. The method of Claim 52, wherein said at least two optical recorders are two-dimensional cameras.

55. The method of Claim 52, wherein said at least two optical recorders include an electronic imaging detector comprising a pixel array and said

step of assigning coordinates is either in parallel to the pixel array or normal to the pixel array.

56. The method of Claim 47, wherein said step of assigning coordinates is in alignment with the virtual calibration pattern.

57. The method of Claim 47, wherein the coordinates are assigned arbitrarily.

58. The method of Claim 47, wherein said compensating step is performed mechanically or electronically.

59. A method of calibrating an optical recorder of a three-dimensional imaging system, comprising the steps of:

projecting a calibration pattern at a calibration wavelength on a plane that is tangent to the nearest point of a desired object as measured from the optical recorder;

labeling an intersection point P between said calibration pattern and the desired object;

positioning the end of a laser light beam operating at said calibration wavelength at the point P;

measuring the distance from the point P to said calibration pattern;

generating a second calibration pattern at a greater distance from the optical recorder; and

repeating said steps of labeling, positioning, and measuring when said second calibration pattern intersects the desired object.

60. The method of Claim 59, wherein the intersection of said calibration pattern with the desired object includes a plurality of intersection points, said method further comprising the steps of:

labeling a subset of said plurality of intersection points in numerical order starting with a first point and continuing to a last point; and

repeating said steps of positioning and measuring starting with the first point and continuing through the subset to the last point.

61. The method of Claim 59, further comprising the steps of:

generating a second calibration pattern at a greater distance from the optical recorder; and

repeating said steps of labeling, positioning, and measuring when said calibration pattern intersects the desired object.

62. A method of calibrating a three-dimensional imaging system relative to a desired object to be imaged, at least two optical recorders to be calibrated, and two holographic calibration plates placed in the field of view of a respective one of the at least two optical recorders wherein each of said holographic calibration plates contains the same hologram, comprising the steps of:

positioning the calibration plates relative to each other to approximate a monolithic calibration plate;

projecting a calibration pattern in the field of view of the desired object through each of the calibration plates;

determining the position of at least three reference points in the vicinity of the desired object relative to each of the at least two optical recorders;

determining a corresponding position on the calibration pattern corresponding to each reference point;

determining the misalignment of the virtual calibration pattern;

determining the correction factors as a function of position of the desired object relative to each of said at least two optical recorders; and

applying the correction factors to each of said at least two optical recorders.

63. The method of Claim 62, wherein said correction factors include shift, rotation and scaling in an orthogonal coordinate system as a function of position of the desired object in three-dimensional space.

64. Apparatus for calibrating a three-dimensional imaging system relative to a desired object, the desired object being illuminated by desired wavelengths, comprising:

acquiring means for acquiring an optical image of the desired object from at least two positions;

a holographic calibration plate placed between said acquiring means and the desired object; and

a light source of at least one of a set of calibration wavelengths for illuminating said holographic calibration plate so as to project at least one virtual calibration pattern in the field of view of said acquiring means and in the vicinity of the desired object.

65. The apparatus of Claim 64, wherein said acquiring means is a single optical recorder that moves between a reference position and a displaced position.

66. The apparatus of Claim 65, wherein said single optical recorder is a three-dimensional camera.

67. The apparatus of Claim 65, wherein said single optical recorder is a two-dimensional camera.

68. The apparatus of Claim 64, wherein said acquiring means is at least two optical recorders, one of which is located at a reference position and another of which is located at a displaced position.

69. The apparatus of Claim 68, wherein said at least two optical recorders are three-dimensional cameras.

70. The apparatus of Claim 68, wherein said at least two optical recorders are two-dimensional cameras.

71. The apparatus of Claim 64, wherein said light source is placed on the side of said holographic calibration plate that contains the desired object.

72. The apparatus of Claim 64, wherein said light source is placed on the side of said holographic calibration plate that contains said acquiring means.

73. The apparatus of Claim 64, wherein said holographic calibration plate has a shape that is planar, cylindrical, elliptical, or spherical, including a subset of these shapes.

74. The apparatus of Claim 64, wherein said calibration pattern has a shape that is cubic, cylindrical, or spherical.

75. The apparatus of Claim 64, wherein said calibration pattern includes a multidimensional wireframe of arbitrary shape with intersecting locations.

76. The apparatus of Claim 75, wherein said intersecting locations are labeled.

77. The apparatus of Claim 76, wherein said intersecting locations are labeled with numerals and/or bar codes.

78. The apparatus of Claim 64, wherein said holographic calibration plate has multiple, superimposed holograms recorded at different calibration wavelengths.

79. The apparatus of Claim 64, wherein said holographic calibration plate has multiple holograms recorded at different calibration wavelengths and at different positions on said holographic calibration plate.

80. The apparatus of Claim 75, wherein illumination of said holographic calibration plate with different calibration wavelengths produces virtual calibration objects comprising multidimensional wireframes of arbitrary shape of varying levels of detail and displacement.

81. The apparatus of Claim 64, further comprising a mirror that is reflective to said calibration wavelengths but is transparent to said desired wavelengths, said mirror being placed in the field of view of said acquiring means.

82. The apparatus of Claim 64, wherein the desired object reflects the desired wavelengths, which are optically separable from said calibration wavelengths.

83. The apparatus of Claim 64, wherein the desired object reflects the desired wavelengths, which are not optically separable from said calibration wavelengths.

84. The apparatus of Claim 64, further including wavelength selection means for separating the desired wavelengths from said calibration wavelengths; calibration electronics for processing said calibration wavelengths and the desired wavelengths; a first memory for storing data related to said calibration wavelengths; and a second memory for storing data related to the desired wavelengths.

85. The apparatus of Claim 84, wherein said wavelength selection means is either a wavelength selection filter or a CCD array.

86. The apparatus of Claim 84, wherein said calibration electronics includes a band pass filter and a band stop filter.

87. The apparatus of Claim 64, further comprising a shutter interposed between said acquiring means and the desired object, said shutter being operable to produce an image of the desired object from said calibration wavelengths for at least one frame and an image of the desired object from the desired wavelengths for at least one other frame.

88. The apparatus of Claim 64, further comprising a material that is reflective of at least one of said calibration wavelengths and that may be applied to the desired object at predetermined points.

89. The apparatus of Claim 64, further comprising a laser pointer which illuminates a point on the desired object with one of said calibration wavelengths.

90. The apparatus of Claim 64, further comprising a laser ranging calibration device which illuminates a point on the desired object with one of said calibration wavelengths.

91. The apparatus of Claim 6 4, w herein said holographic calibration plate includes a plurality of holographic calibration plates, each of said plurality of holographic calibration plates containing the same recorded hologram.

92. The apparatus of Claim 64, wherein said field of view of said acquiring means includes at least three reference points that are illuminated at said calibration wavelengths.

93. The apparatus of Claim 92, further comprising a beam of light that illuminates said at least three reference points with said calibration wavelengths.

94. The apparatus of Claim 64, further comprising a band stop filter located between the desired object and said holographic calibration plate for preventing an illuminating wavelength from an intruding hologram source from traveling to the vicinity of the desired object.

95. The apparatus of Claim 64, further comprising a stereoscopic microscope placed between the desired object and said holographic calibration plate.

96. The apparatus of Claim 64, further comprising a plate on which is imprinted a desired object to be identified.

97. Apparatus for calibrating a three-dimensional imaging system relative to a desired object to be imaged, comprising:
at least two optical recorders; and
a light source of at least one calibration wavelength for illuminating at least three reference points relative to the desired object to be recorded by said at least two optical recorders.